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SECRET

CLASSIFICATION CANCELLED
by authority of
THE SURGEON GENERAL
DATE APR 10 1950
MAJOR FRANK B. ROGERS, MC
Historical Division

SECRET

Vol. I No. 11 Malaria Control, Hq Base G, APO 565 25 Oct 1944

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It has been noted that many units are operating under strength. In view of impending operations it is important that this situation be remedied. In order to function efficiently and properly it is necessary to have all of your personnel and equipment in tip-top shape. Many of the commanding officers who have been anxious to move forward should bear in mind that the above factors may have a direct bearing on their selection for a move.

Many units have not sent in their unit rosters as requested in our Ausgust issue. Undoubtedly, some of you have failed to receive all of our issues. Drop us a line if such is the case. The movements of units has probably been an important factor. Let's have those rosters, eh?

If unit commanding officers will look up W. D. Circular No. 30, 23 January 1943, they will find information to the advantage of their mail orderly. -- A word to the wise!

Once again, we ask all units to pass along any and all items of interest to malaria control workers, for publication in this newsletter. It may be of interest to our subscribers to know that this publication has world-wide distribution. Favorable comments have been received from many of the theaters as well as Washington D. C. How about it?

The 213th Medical Composite Unit (Malaria Survey) reports: "The Army Medical School confirmed the diagnosis of a triple infection (P. vivax, P. falciparum, P. malariae) in a Treasury Island boy age 10 . . . "

ARMED FORCES
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The 40th Malaria Survey Unit, which is located at Finschhafen, reports that Aedes albitarsis, not previously collected here, was found in small numbers breeding in coconuts in September.

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A Reminder

Major Francisco Dy, now of the Philippine Civil Administration, has requested a copy of all survey unit reports from the Philippines. This can best be handled by submitting 2 copies to the Chief Malariologist. Please include all maps where necessary.

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RELATIONSHIP OF DDT CONCENTRATION
TO MINIMUM OUTPUT OF EQUIPMENT
Guadalcanal, June--August 1944

EQUIPMENT	Minimum Output gal/acre	DDT - OIL SOLUTION Recommended Concentration Maximum Percent	Maximum Lbs DDT per acre	Minimum Percent	Minimum Lbs DDT per acre
Knapsack and C. W. Decontamination sprayer	5-7	2.5	1.2*	1	0.48*
"Flit Gun" type sprayer	1.2-2	5	0.6*	2.5	0.3*
Airplane	0.5	5	0.2	5	0.2

*Pounds of DDT/acre for "Flit Gun" sprayers calculated on output of 1.5 gal/acre, for knapsack and C.W. decontamination sprayers on output of 6 gal/acre.

The minimum concentrations of DDT in oil shown in the above table gave approximately 100 percent kill when properly applied and were apparently as effective as the maximum concentrations. The 5 percent solution was decreased to 2.5 percent for use in the Flit Gun type sprayer and to 1 percent for use in knapsack and C.W. decontamination type sprayers when it was found that the delivery in gallons per acre of these latter types was not reducible below 1.2 to 2 gal/acre and 5 to 7 gal/acre respectively, using available nozzles and labor. Data in above table was obtained on Guadalcanal. Similar work was under way on other bases, and it is hoped that critical evaluation of these results will be reported from several bases.

The use of DDT resulted in an economy of labor and of diesel oil. WD TB Med 14 states that the average consumption of plain diesel oil is 10 to 14 gallons per acre. A medical sanitary company on Guadalcanal larviciding in an area of heavy troop concentration and poor soil drainage, estimated that their output of plain oil was 20 to 30 gallons per acre of water surface during the wet season. This sanitary company, equipped with flit guns reported that their monthly output of DDT-oil solution over a stipulated area was 150 gallons. This amount was 10 percent of the 1500 gallons of plain diesel oil formerly required to cover the same area with knapsack sprayers. Other advantages were in the decreased weight carried by each field man and the less frequent filling of sprayers and replenishing of oil depots.

These potential economies were limited by two factors: the equipment to disperse adequately the smaller amounts of DDT in oil and the personnel to use this equipment. The airplane spray unit and the hand operated "Flit Gun" type sprayer were the most economical means of distribution. It was considered that these instruments were susceptible to only minor improvements and that no significant reduction in the amounts delivered per acre was possible (see table). However, the knapsack and C.W. decontamination type sprayers were expected to produce a finer spray and thus reduce their delivery in gal/acre, when modified by spray discs* with smaller apertures than those now available. Even so, it was doubtful if these instruments would deliver less than 4 gal/acre when used by the varied personnel available for larviciding. This personnel consisted of medical sanitary companies (colored), natives and troop antimalarial details. These troops wanted to see the results of their labor in the form of a visible film of oil. Constant precaution against overdosage was necessary.

The introduction of DDT did not alter the weekly larvicidal schedule although it was felt that it would probably obviate the occasional need for a shorter schedule. Heavier applications of DDT in a few static pools gave a residual larvicidal effect for longer periods. However, the chief breeding areas were of a nature which did not lend themselves to larviciding for residual effect. This fact and the heavy rainfall during the wet season made it probable that the weekly larvicidal schedule would be maintained for the major portion of control work.

Mixing DDT with oil did not present great difficulties. The 1 and 2½ percent solutions offered no problem. The 5 percent solution was best obtained by adding DDT to oil previously warmed by the sun's rays. The mixing was hastened by agitation with a mechanical mixer or any simple device for bubbling air through the DDT-oil mixture. Solutions were prepared 24 hours or more prior to use. DDT was supplied in 10 pound cans and was mixed with diesel oil in the following proportions to obtain approximate concentrations:

5 percent solution: 2 ten pound cans DDT/55 gal. oil
2½ percent solution: 1 ten pound can DDT/55 gal. oil
1 percent solution: ½ ten pound can DDT/55 gal. oil

The toxicity of DDT was so great that the exact percentage was not a critical matter and the concentrations noted were adequate for field purposes.

The equipment for application of DDT was as follows: The 5 gal. knapsack sprayer and the 3 gal. C.W. decontamination sprayer are considered together. The former was the only instrument available in adequate number. The latter was lighter to carry and more durable. It required a new nozzle for successful use of DDT solutions. The natural rubber hose on both of these sprayers deteriorated rapidly after contact with oil and small particles of rubber broke off and clogged the screen, whirl plates and spray disc. An unauthorized remedy was to discard those parts and apply a stream of oil to the water surface. Consequently the majority of these sprayers required new screens and whirl plates as well as spray discs with smaller apertures to adapt them for use with DDT solutions. Plastic nozzles were also unsuitable. Neoprene or other oil resistant hose and fittings of the same material were requisitioned. The increased coverage obtained by a proper application of DDT-oil solutions so reduced larvicide consumption that those sprayers were filled to only ½ or 2/3 capacity, which reduced the hazard of spilling on the field worker.

The "Flit Gun" type sprayer which was equipped with an atomizing nozzle was the most useful instrument available. It was listed as M Item, 41-S-4106, Sprayer, liquid, insect, continuous spray. Heavier and more durable models were requisitioned for field work. This sprayer delivered a fine mist which was effectively applied in still air or when aided by a wind drift. Operators were trained to take advantage of wind direction to obtain maximum coverage with minimum amount of larvicide and effort. A visible film of oil was not always detectable on the water and was not a necessary criterion of adequate coverage. The best criterion of coverage was a larval survey before and 24 hours after spraying.

* No. 2 disc. Present aperture may be brazed and drilled with No. 60 wire drill.

The above article was quoted from the South Pacific Area News Letter of August 1944. (Navy)

The following article is extracted from a report made by Captain John M. Weir, M.C., Malariologist located on Green Island.

"It may be of interest to other areas to remark upon one method used at this base for control of small pools of water which cannot be eliminated economically. Bags of burlap are filled with saw dust and soaked in a 5% solution of DDT in diesel oil. These are placed in the pool of water and left for as long as the water remains. One bag will continue to control breeding for many weeks and no additional oiling is necessary. One bag per 200 square feet of surface water is adequate."

MEDICAL ENTOMOLOGY OF THE PHILIPPINE ISLANDS

(Extracted from Report of Medical and Sanitary Data on the Philippine Islands, S.G.O., 8 May 1944)

Aedes

Approximately 35 species of Aedes mosquitoes have been found in the Philippine Islands. Only two of these, A. aegypti and A. albopictus are of medical importance, however. Both of these mosquitoes are vectors of dengue fever. A. aegypti is also the principal vector of yellow fever in other areas, while A. albopictus has been found capable of transmitting yellow fever experimentally. Fortunately this disease has never appeared in the Philippine Islands.

a. A. aegypti is an essentially domestic mosquito. It breeds near houses, in puddles, and in artificial collections of water, such as are found in barrels, tin cans, cisterns, and other small receptacles. It prefers rain water, but will also deposit its larvae in brackish wells. The first blood meal of this mosquito is always taken in dim daylight after which it becomes a nocturnal biter. Its flight range probably does not exceed 200 yards.

b. A. albopictus is also domestic in its habits. It breeds by preference in tree holes, bamboo stumps and leaf axils in the vicinity of inhabited buildings. When such breeding places are not available, it will deposit its larvae in small artificial receptacles. It shows a decided preference for human blood, feeding mainly during the day, and is said to be an even more vicious biter than A. aegypti. In and near Manila, it is especially prevalent during June and July.

Culex

Approximately 17 Species of Culex mosquitoes are found in the Philippine Islands. C. fatigans, which transmits filariasis due to W.bancrofti, is the only species of medical importance in this area. C. vishnui is a vector of W.bancrofti in India and possibly in the Netherland East Indies, but does not appear to transmit filariasis in the Philippine Islands.

a. C. fatigans is usually a domestic mosquito, breeding by preference in cisterns, jors, tin cans, gutters, and other small artificial collections of water. Sometimes, however, it deposits its larvae in stagnant or semi-stagnant ground water far from human dwellings. It is almost exclusively a night biter.

b. C. vishnui breeds in both still and running water, but never in brackish water. Its larvae are found in small pools and puddles, in drainage ditches, in lakes, and along river banks.

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EFFECT OF TEMPERATURES ON KNOCKDOWN AND KILL OF INSECTS EXPOSED TO DDT

as reported by researchers of the Bureau of Entomology and Plant Quarantine, Division of Insects Affecting Man and Animals, Orlando, Florida.

The fact that flies exposed to DDT were knocked down and succumbed more rapidly at temperatures of 70 or 80 degrees than at 90 or 100 degrees has an important bearing on control. It is possible that DDT will give better results in climates having comparatively low day and night temperatures than in climates having high temperatures both day and night.

Since A. quadrimaculatus were knocked down more slowly at low temperatures, it is possible that climate and temperature will have a considerable effect on the results obtained with different species of insects.

In the above tests the humidity was maintained at 60 to 70. Accordingly, all indications are that conditions are most favorable in the New Guinea area for experimental work on DDT.

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The following article is quoted from the Navy South Pacific Newsletter No. 15 for the month of September.

"The value of treating tents with DDT was questioned by a report in Medical Intelligence Abstracts, Office of the Surgeon General, U.S. Army, 10 July 1944, which is quoted in part: 'DDT-treated canvas tents do not appear to serve any useful purpose, for Anopheles punctulatus var. moluccensis rarely, if ever, rests upon tent walls before biting and does not settle on the treated tent walls after a blood meal.'

"This was contrary to findings of entomologists in this area who have repeatedly taken the local anophelines, blooded and unblooded, resting in pyramidal tents in native labor camps and in villages of indigenous natives. Mosquitoes were most frequently found in tightly closed dark tents and in those filled with impedimenta, rarely in tents open to air and light. The maximum number of anophelines taken in one tent in one day was 100. Further studies were instituted. In the meantime the treatment with DDT spray of tents to be used in highly malarious areas was continued.

"The species referred to in the preceding paragraph were Anopheles punctulatus punctulatus, Anopheles punctulatus farauti (formerly called Anopheles punctulatus moluccensis) and a variety of Anopheles punctulatus new to Guadalcanal."

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The following extract is taken from the August report of the 28th Malaria Survey Unit.

As part of a study of the history of exposure of the 12th Cavalry Regtiment during the Admiralty Islands Campaign, a series of 290 thick blood smears were taken from natives on Eam utyo Island where troops from the 12th Cavalry Regiment were under combat conditions for about three weeks.

Slides were obtained from five villages, Ndriol, Lankau, Busu, Penchal and Matembok, and spleen palpations were made on the children of the first three villages.

Results of the spleen survey (consolidated) are given below:

Age	0	PDI	I	II	III	IV
0-2				3	2	2
3-5	2	2	4	14	5	
6-10		2	8	6	6	
11-15		1	3	6		

The breakdown for the blood smears by villages is as follows: Ndriol, 42% positive; Lenkau, 40%; Busu, 33.3%; Penchal, 23.2%; and Matembok, 31%. The first three villages were the so-called "Reef Villages", in which the houses are built up on stilts over the water. The last two villages were located in the hills, some distance from the beach. Apparently the natives in the reef villages are exposed to Anopheline mosquitoes as much as the inland villages for there appears to be no significant difference in the percentage infection with malaria. Anophelines were found in or close to all of the villages.

Microfilaria were found in only 2 slides, one from Ndriol, the other from Penchal.

Blood Smear Study on Cavalry Troops.

The results of an atabrine level and blood smear study on troops of the 12th Cavalry Regiment, First Cavalry Division carried out in conjunction with Lt. Bangs' laboratory have been received.

Fifty samples of blood were taken from men chosen at random from two Troops of the 12th Cavalry Regiment and atabrine levels in terms of gamma/liter were determined. (One of the samples was unfit for examination) Twenty samples showed 10 or less gamma/liter, 17 showed 20 or less, 6 showed 30 or less and 6 showed over 30.

Thick blood films were taken from these 50 men and from 150 other individuals. Of the fifty men on whom atabrine levels were determined, five showed malaria parasites as follows: one with 2 trophozoites of P. vivax per 500 W.B.C. (atabrine level 17 gamma/liter); one with 3 amoeboid forms of P. vivax per 500 W.B.C. (atabrine level 7 gamma/liter); and 3 with single rings per 500 W.B.C. (atabrine levels 16, 5 and 0 gamma/liters). One individual in the group of 150 from whom no atabrine levels were determined showed 2 rings per 500 W.B.C. No gametocytes were found in any of the positive slides. Only one of the men showing parasites had a previous history of malaria.

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The following DDT tests are quoted from the report of Lt. Robert Staples, SnC, of the 1st Malaria Survey Unit.

On 11 August a very heavily vegetated pond in the 37th Division area was sprayed with a 5% DDT in oil solution by means of Flit guns. Approximately 1.75 gallons of spray material per acre of water surface was used on the border of the pond. Formerally Diesel oil had been employed, but due to the excessive vegetation, the results were negligible. To ascertain the effects of the DDT in oil, larval surveys were made the day before the insecticide was applied and at convenient intervals after the time of application. One side of the pond was used as the check area. In this check area the vegetation is thick and rank except for a point jutting out into the pond at one end of the area where the vegetation has been partially removed. On this point Culex annulirostris breeds in great numbers while along the rest of the check area the predominant species belong to the genus Uranotaenia. The following table presents the results of the larval surveys before and after the DDT in oil was applied. The number of Anopheles collected is given as the numorator and the number of Culicines as the denominator.

	On Point			Rest of Check Area		
Date	Result	No. dips	No./100 dips	Result	No.dips	No./100 dips (Culicines)
10 Aug, day before DDT applied	Hundreds of Culex, all instars*			3/811	180	451
14 Aug, 3 days after DDT app'd	0/65	50	135	0/40	200	20
18 Aug, 7 days after DDT app'd	Hundreds of Culex, 1st and 2nd instars*			4/490	200	245
21 Aug, 10 days after DDT app'd	Hundred of Culex, all instars*			6/721	190	380

* The larvae on the point were so numerous that no attempt was made to count them.

This data indicates that in water where there is a high degree of vegetation, DDT in oil when employed with Flit guns gives a material reduction in larval breeding and that it lasts in effect for approximately seven days.

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Attention all Unit C.O.'s & Malariologists.

It is now unecessary to submit a copy of reports to the Ass't. Chief Malariologist. One copy direct to the Chief Malariologist USAFFE will be sufficient. (Survey Unit C.O.'s see item 7 page 1.)

Blood Survey of Natives of the Sansapor-Cape Opmarai Area with Summaries of Findings on Three Groups Studied.

made by

26th Malaria Survey Unit

1. Method. Thick and thin blood smears were taken on a large sampling of the native population. Out of an estimated 300 inhabitants of this village 216 slides were taken. These slides were made between the hours of 0900 and 1030 a time of day during which microfilariae would be scarce if not absent in the circulating blood of infected persons. For that reason figures on filiariasis are of no particular value, but routine examination for these parasites was made in the process of examination of Giemsa stained thick and thin films, for the presence of malaria parasites.

2. Findings. Examination of thick and thin blood films for malaria parasites gave the following results: 102 adults were entirely negative; 114 children gave 12 positives, 3 of which were P. falciparum, and nine of which were P. vivax. An incidence of 5.5% is recorded for the entire series of 216 natives examined with an incidence of 10.5% in children. Four adults and one child showed microfilariae of Wucheraria Bancrofti.

3. Interpretations and Comparisons. It is noteworthy that this is the lowest malaria incidence rate found in any group of natives studied in the S.P.A. (Unreported survey excepted). Each slide was checked by at least four experienced technicians, and the methods employed for preparation of materials were standard. For this reason it is believed that technique can be dismissed as a factor accounting for the rates found in this survey. A comparision of findings at this and other locations in New Guinea follows:

	No. Studied	Total % Positive	P.V	P.F	P.M
Lae and Wau	53 adults	32	26	6	0
Saidor	48 adults	38	21	17	0
Waab (Base G)	129 children	68.5	6.2	24	33
Sansapor	114 children	10.5	7	3.5	0
Sansapor	102 adults	0			
Sansapor	75 adults	2.6	1	1	
Sansapor	76 adults	0			

The explanation which may lie behind the extremely low rate among natives at this base could not easily be arrived at. Survey of mosquito breeding conducted by this unit at APO 159 to date covers an area approximately four miles in length extending inland to and beyond all inhabited areas. Anophelines were found in only three collections throughout this survey conducted over a period of eight weeks. Those findings suggest the possibility that certain areas including this one are not hyperendemic and that under natural conditions malaria is not spread to all native inhabitants, because of the scarcity of effective vectors. If this is true the common belief that all portions of the New Guinea coast are highly malarious is erroneous. In this series of 114 children, 11 were infants in arms, and lonly one of this group was positive. In a similar check conducted by this unit at Cape Gloucester, New Britain, four out of five infants in arms or 80% were positive. The wide variation in findings in this comparable age group, where malaria would not be likely to be chronic seems significant and is again suggestive of the possibility that efficient vectors are not present in sufficiently large numbers under natural conditions to pass the infection to all individuals inhabiting the area.

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Studies on Protective Clothing

by

Lt. R. Staples, SnC, 1st MSU

In compliance with a request from the Office of the Surgeon General, dated 3 July 1944, tests were run to determine as far as possible the efficacy of the new jungle suits in comparison with the standard herringbone twill fatigue and cotton khaki uniforms in warding off the attacks of mosquitoes. The two jungle suits, one a poplin material and the other a heavier twill, were received in an unworn condition and were washed in boiling water before the tests were made. For the most part these garments were tested in the field where the predominant species was Aedes funereus ornatus. Six individuals were employed and the clothes were tested in both a wet and dry condition in areas that had the greatest adult population. Considerable clearing had been done in the test area and in order to conduct the experiments the weekly oiling of the area was suspended. An attempted bite was considered to exist when a mosquito landed on some portion of the clothing drawn tight against the flesh of the test subject and an active probing with the proboscis in an attempt to penetrate the fabric was observed. Head nets and gloves were used in lieu of repellant by the test subjects while in the field, larvae were brought into the laboratory and the adults allowed to emerge. These adults were then placed in a small screened cage into which the test subject while wearing a glove over his hand could place his arm. Observations were then made on the attempted bites and the actual bites through the fabric on the arm of the test subject.

Summary of Findings

Clothing used:	Jungle suit, poplin, new		Jungle suit heavy, new		Fatigues, Herr. twill		Cotton khanki	
Condition :	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
Attempted bites in laboratory with Anopheles:	51	72	69	60	53	78	61	48
Actual bites in laboratory with Anopheles :	0	0	0	0	0	0	0	0
Total attempted bites in field and laboratory (all species):	2004	1215	973	1017	915	1083	1040	1192
Total actual bites :	0	1	0	1	0	4	2	1

The mosquitoes that penetrated the new jungle suits were Culex (Lutzia) halifaxi. Those penetrating the dry herringbone twill fatigues were Aedes funereus ornatus. One Aedes funereus ornatus and one Aedes carmenti penetrated the same garment in the dry condition. From the evidence presented by these tests it would appear that the two new jungle suits and the herringbone twill fatigue and cotton khaki uniforms offer excellent protection from the bites of mosquitoes.

A note about Philippine sandflies quoted from the "Medical Entomology of the Philippine Islands."

"At least seven species of sandflies are reported in the Philippine Islands, but apparently do not transmit disease. Their distribution by islands is not known. The species which have been identified are: Phlebotomus nicnic, P. dayapensis, P. heiseri, P. kitchensi, P. manganus, P. philippinensis, and P. torrechartei."

SECRET

Use of DDT in the Control of Flies and Fly Larvae.

from report made by

Capt. D. P. Furman, SnC, 40th M S U

Technique.

A five percent solution of DDT in #2 diesel oil was used as a spray. The material was applied to exterior surfaces by means of a knapsack sprayer. Interior surfaces (inside the latrine box) were treated with a 1½ quart decontamination apparatus, M2. Each of these produced a rather coarse spray, which was more suitable for the work at hand than a mist spray.

The tests were conducted on five, standard, 8-hole, pit latrines located in a hospital area. They were without screens or roofs. Fly counts were obtained from all latrines for several days before treatment. The fly counts were obtained by placing a screen fly trap over an open hole of each latrine. Flies thus obtained were removed and counted daily. Four of the latrines were treated with DDT spray while the fifth was retained as a control.

(1) The control latrine was subjected only to such treatment as had been previously used, on all latrines, ie: Latrines were scrubbed daily with soap and water, sprayed with germicide, and dichlorinated lime applied to the pit. The control latrine was burned out twice.

(2) The test latrines were subjected to the daily treatment of the control latrine with the exception that they were neither oiled or burned out, nor sprayed with pyrethrum insecticide. In addition, each test latrine was sprayed initially with five percent DDT spray at the rate of one gallon per 500 square feet. This was applied to walls, seats, interior of latrine, and ground about the box. Forty-eight hours after the initial treatment and subsequently at twenty-four hour intervals, the interior of each latrine box was sprayed with one pint of the DDT spray. This was a spray rate of approximately one pint per 300 square feet of surface.

Discussion and Conclusions.

From previous tests it is well known that DDT often does not kill insects coming in casual contact with it immediately. This phenomenon would naturally be obscured immediately following a heavy spray application of DDT in oil, because an oil spray alone of the same intensity would give a high initial kill. The effect of the delayed action is seen on succeeding days, however, as represented by the relatively large numbers of flies in traps over treated latrines, with the great majority of the flies dead in the traps. The brief contact with DDT in the latrine thus showed it's lethal effect.

The biology of the fly, Calliphora sp., in this area is such that the life cycle from egg to adult may be passed in eight to fourteen days. Thus if the adult population emerging subsequent to treatment of a latrine is destroyed before it is able to deposit eggs, a marked decrease in emerging flies should be observed approximately eight days following treatment.

The effect of DDT on developing larvae in latrines is apparently not too great. This is substantiated by the numbers of flies continuing to emerge from the latrine over a period of seven days following treatment, although the majority of these flies were soon destroyed as adults by the DDT.

After fourteen days the latrines were given no further treatment, but collections were made on the 18th and 21st days following the original treatment. The total number of flies collected from treated and untreated latrines was approximately the same on these days, but as before only approximately 5 percent of the flies obtained from the treated were alive when the traps were picked up. Further tests on the residual effect of DDT were cut short because noxious odors from the latrines necessitated burning them out, thus obscuring the effects of the DDT.

Conclusions: Five percent DDT in #2 diesel oil gives approximately 84 to 98 percent improvement in fly control as compared with the usual methods of treating latrines. The above applies to the fourteen days following initiation of control measures.

(1) The foregoing experiments undoubtedly were conducted with much greater amounts of DDT than would be necessary to obtain a comparable control. Further investigation should shed light on the effects of an initial heavy treatment followed by no daily application of DDT spray. The attempt to do this in this series of experiments was interrupted seven days following the start of the test, but results showed an effective residual killing effect during this period.

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Captain Bruce E. Casse and 1st Lt. Joseph H. Latimore of the 3rd and 26th Malaria Control Units report on the use of DDT in flit guns and the utilization of the M-20 Smoke Tank in the application of Diesel Oil. They also describe the airplane application of DDT.

"Features of the month's Larvicidal program consisted of establishment of a DDT flit gun squad to treat ground pools and use of M-20 smoke tank in application of diesel oil. Use of a flit gun to dispense DDT minimizes effort required and conserves materials. The crew established is currently devoting its attention to areas of numerous isolated infestations, supplementing the work of knapsack sprayer crews. The M-20 smoke tank is being used by a hand spraying crew to expedite coverage of easily accessible pools. The M-20 smoke tank with an air pressure of 65-70 pounds will dispense 40 gallons of oil. Ordinarily this is sufficient for a half day's operations.

The advantages of the M-20 tank are as follows: (1) Compact and light - easily transferred from one vehicle to another. (2) Another is that no motor is needed, eliminating trouble that often arises from operation of motor. (3) Constant pressure on the rubber hose minimizes breakage of the rubber. (4) Leakage is minimized due to sturdy construction."

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A Note on Vertical Drainage

"The elimination of road ruts has been aided by a unique type of vertical drainage that has been called "the divining rod in reverse action." The ruts average six inches in depth and are water filled much of the time. Elimination is done by crews of hand laborers. Two men head the crew, with a drill-like rod, about the diameter and weight of a crowbar, but eight or nine feet in length. The rod is forcefully driven down through the water and thin layer of soil into the soft coral beneath. A single strong blow will often sink the rod to a depth of six feet or more, and as much as twenty gallons of water will drain away in a few minutes. Large pools holding several hundred gallons of water have been rapidly drained by multiple holes. The space thus freed of water is filled in by other members of the crew, and the road is closed to further traffic."

The above article was quoted from the Navy South Pacific Newsletter No. 15 for the month of September.

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The following article is quoted from the "Medical Entomology of the Philippine Islands"

"MITES. Trombicula akamushi, vector of Tsutsugamushi disease in Japan and Formosa is present in the Philippines, although this disease has never been definitely reported from these islands. Under present conditions, however, it could be easily introduced by Japanese soldiers. In Japan, the field mouse, Microtus montebelloi is the host of this mite. Its host in the Philippine Islands is not named in available reports. T. akamushi is probably found on all of the larger islands under consideration although its exact regional distribution cannot be given. The itch mite, Sarcoptes scabiei is very common throughout the Archipelago. Echinolaelaps echidninus, a parasite of rats, infests houses in the Philippine Islands, but does not bite man.

The following information is extracted from The Philippine Journal of Science, Vol. 49 No. 3, November 1932, Malaria and Anopheles Reconnaissance in the Philippines by Rufus L. Holt and Paul F. Russell.

Species of Anopheles
encountered in survey and number of times found.

Serial No.	Species.	Times collected.
1	Anopheles aitkeni	5
2	Anopheles barbirostris	254
3	Anopheles fi[illegible]inae	68
4	Anopheles fu[illegible]ignosus	35
5	Anopheles gigas var. formosus	7
6	Anopheles hyrcanus var. nigerrimus	17
7	Anopheles hyrcanus var. sinensis	48
8	Anopheles insulae florum	14
9	Anopheles karwari	2
10	Anopheles kochi	6
11	Anopheles leucosphyrus	0
12	Anopheles lindesayi var. benguetensis	6
13	Anopheles litoralis	10
14	Anopheles ludlowi	25
15	Anopheles maculatus	109
16	Anopheles mangyanus	50
17	Anopheles minimus	378
18	Anopheles parangensis	0
19	Anopheles philippinensis	21
20	Anopheles pseudobarbirostris	30
21	Anopheles subpictus var. indefinitus	61
22	Anopheles tesselatus	15
23	Anopheles umbrosus	4
24	Anopheles vagus var. limosus	53

Malaria and the A. minimus group were always closely associated, but the mere fact of association with malaria is obviously not enough to prove that a mosquito is a malaria carrier. It must be remembered that in order to be a factor in the transmission of human malaria in any give region a species of Anopheles must obviously have certain characteristics. It must be distributed in sufficient numbers close enough to habitations. It must desire human in preference to animal blood and strongly enough to enter houses for meals. Finally, it must be susceptible to infection. Not a great deal is known about the interplay of these factors in the life history of Philippine anophelines.

The first requirement of density in numbers and proximity to habitations is fulfilled by a majority of the Philippine Anopheles. As to the second factor, very little information is available. Only the work of Laurel (51,52) has been published. This observer found that thirty-one out of thirty-nine blood meals of A. minimus ("funestus") reacted for human and none for animal tests. The reverse was true of eight other species, including A. barbirostris. Of the latter, thirteen were tested; seven reacted to cow sera, none to human.

Anopheles minimus adults are rarely taken inside human habitations in the daytime, as noted by Russell, (53, 54) but large numbers may be trapped if a sleeping human is used for bait. See Manalang, (47, 55). Numbers have been caught in bed nets. See Barber et al. (1)

As to the final test; namely, the susceptibility to infection, a great deal more information is required. The first work to determine susceptibility was done by Banks, (56) who claimed to have experimentally infected Hyrcania ludlowi. Since his mosquitoes came from salt water they were probably of the species that King has named A. litoralis and which is so-called in our classification. This work was inconclusive for, as Manalang (45)

points out, Banks may have been mistaken in his diagnosis of the sporozoites.

Breeding places in which collections were made.

Breeding place.	Times visited.
Streams	318
Rivers	77
Irrigation ditches	72
Pools, fresh water	40
Pools, salt water	22
Lakes	6
Rice fields	4
Wells	4
Ditch, still, unshaded	2
Swamp	1
	546

Classification of breeding places.

Breeding place.	Times visited.
Stream:	
Clear water	266
Muddy water	44
Shaded water	174
Unshaded water	38
River	77
Pool, fresh water	39
Lake	6
Rice field	4
Irrigation ditch	72
Well	4
Salt-water pool or pond	22
Other places:	
Ditch, unshaded	2
Swam	1

Breeding places of A. minimus and/or A. mangyanus.

Breeding place.	Collections of Anopheles minimus and/or A. mangyanus.
Streams:	
Clear water	225
Muddy water	37
Shaded water	141
Unshaded water	23
Bamboo at edge	72
River:	
Clear water	47
Muddy water	7
Shaded water	32
Unshaded water	23
Bamboo at edge	17
Irrigation ditch:	
Clear water	36
Muddy water	9
Shaded water	14
Unshaded water	35

Breeding places of A. minimus and/or A. mangyanus. (Con't)

Breeding place.	Collection of Anopheles minimus and/or A. mangyanus.
Other places:	
Pool --	
Stream, shaded, clear	2
Stream, unshaded, muddy	1
Shaded	2
Unshaded	1
Unshaded, bamboo roots	1
Well --	
Shaded, clear	1
Unshaded, clear	1

The next studies of experimental infection were made by Walker and Barber. (57) Table 21 includes only strictly comparative figures and not the totals. Both gut and gland infections are included.

TABLE 21. -- Walker and Barber's summary of experimental malaria infections in Philippine Anopheles.

Species	Insects dissected.	Infected.	
		Number.	Per cent.
Anopheles febrifer [a]	162	108	66.7
Anopheles maculatus	3	2	66.7
Anopheles rossi [b]	187	35	18.7
Anopheles barbirostris	100	6	6.0
Anopheles sinensis	12	0	0.0

[a] Anopheles febrifer included what in our report is A. mangyanus and perhaps A. filipinae.

[b] Anophelse rossi probably included A. litoralis, A. subpictus v. indefinitus, A. vagus.

A. sinensis is A. hyrcanus v. sinensis.

The remaining published evidence is that of Manalang. (45,47,55,58,59) This observer in thousands of dissections of several Philippine species, including A. barbirostris, A. fuliginosus, A. hyrcanus var. sinensis, A. karwarc, A. maculatus, A. minimus ("funestus"), A. philippinensis, A. subpictus var. indefinitus ("rossi"), A. tesselatus, and A. vagus has only found A. minimus infected. (Whether the infected individulas did or did not include A. mangyanus is uncertain.) On one occasion Manalang (60) found a wild-caught A. maculatus infected but this was after artificial incubation in a laboratory cage. On another occasion one heavily infected stomach was found in A. vagus. (55)

Therefore, all available evidence, at the present time, points to the minimus group as the chief vectors of malaria in the Philippines, but it would indeed be rash to assume that only this group is ever guilty in this Archipelago.

There is no evidence in our reconnaissance that salt-water Anopheles play any part in malaria transmission in the Philippines. Epidemiologically, our results tend to incriminate the minimus group above all others, but our tables do not rule out the distinct possibility that other species may occasionally be transmitting malaria.

The tables below are reproduced from the booklet "Malaria and Anopheles Reconnaissance in the Philippines, II" by Paul F. Russell.

Spleen examinations by provinces.

Province.	Localities Visited.	Examined	Positive
Antique	2	160	48
Bataan	12	1,135	144
Batangas	4	298	47
Carmarines Sur	3	184	42
Cebu	1	225	7
Davao	4	175	10
Leyte	2	118	18
Manila	3	215	7
Masbate	1	99	7
Mindoro	3	103	55
Palawan	4	371	130
Samar	1	47	13
Total	40	3,110	528

Blood smear examinations by locality and findings.

Province and locality.	Examined.	Positive		Species of Plasmodium					Date
				P.v	P.f	P.m	TU	Mix	
			Pct						
Cebu:									
Cebu	5	0	0.0	..	..	..	..	..	Oct 1933
Manila:									
San Andres School	100	0	0.0	..	..	..	..	..	Oct 1933
Palawan:									
Culion, Baldat	24	11	45.8	4	7	..	..	..	Dec 1933
Puerto Princesa School	113	57	50.4	32	23	1	4	3	Dec 1933
Total	242	68	24.1	36	30	1	4	3	.....

Summary of blood-smear examinations.

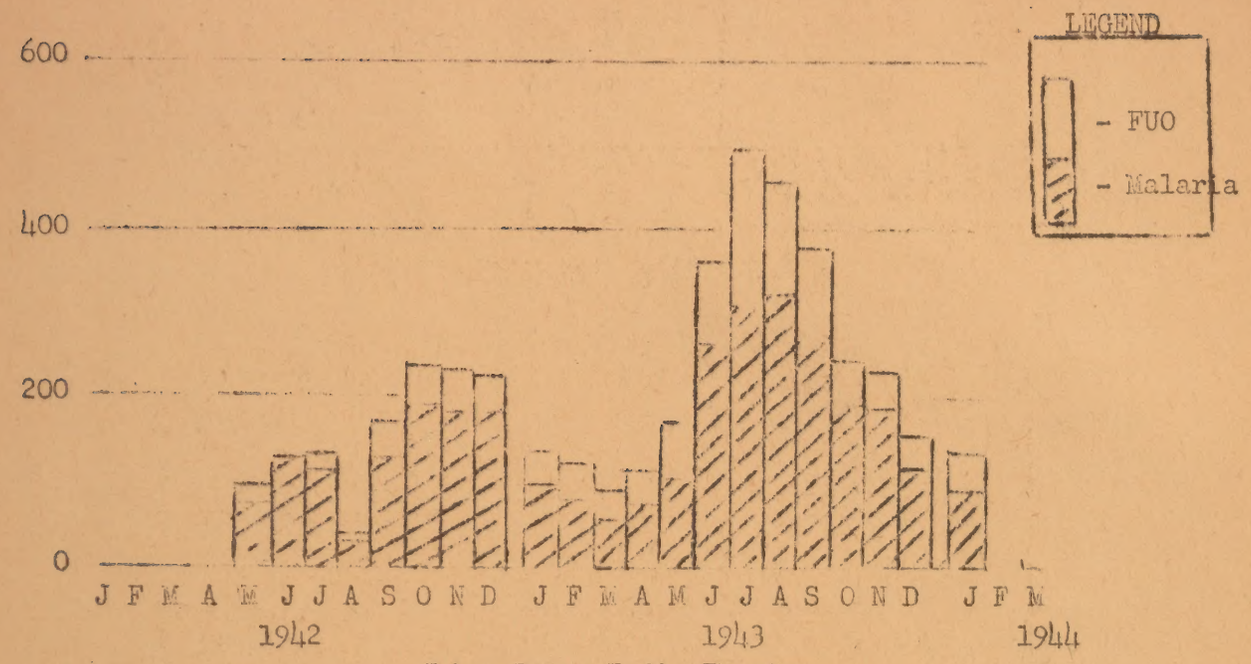
	Number.	Per cent.
Provinces	9	.....
Localities	20	.....
Smears examined	2,302	.....
Smears positive	544	23.6
Plasmodium vivax	328	[b] 60.3
Plasmodium malariae	6	[b] 1.1
Plasmodium falciparum	244	[b] 44.9
Mixed	29	[b] 5.3
Undetermined	11	[b] 2.0

[b] Percentage of positive smears.

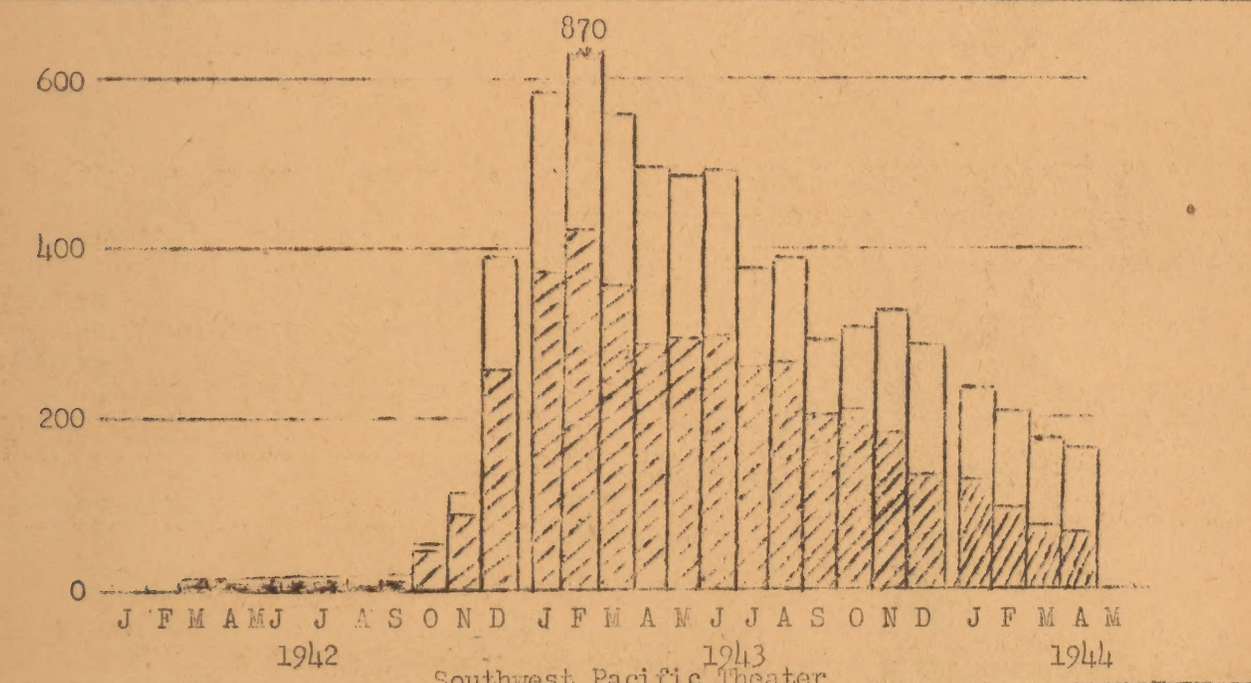
Spleen size and blood smears.

Spleen size	Total smears.	Positive smears.	
		Number.	Per cent.
Negative	521	9	1.7
P. D. I.	114	62	54.4
1	109	71	65.1
2	52	36	69.2
3	26	19	73.1
4	8	7	87.5

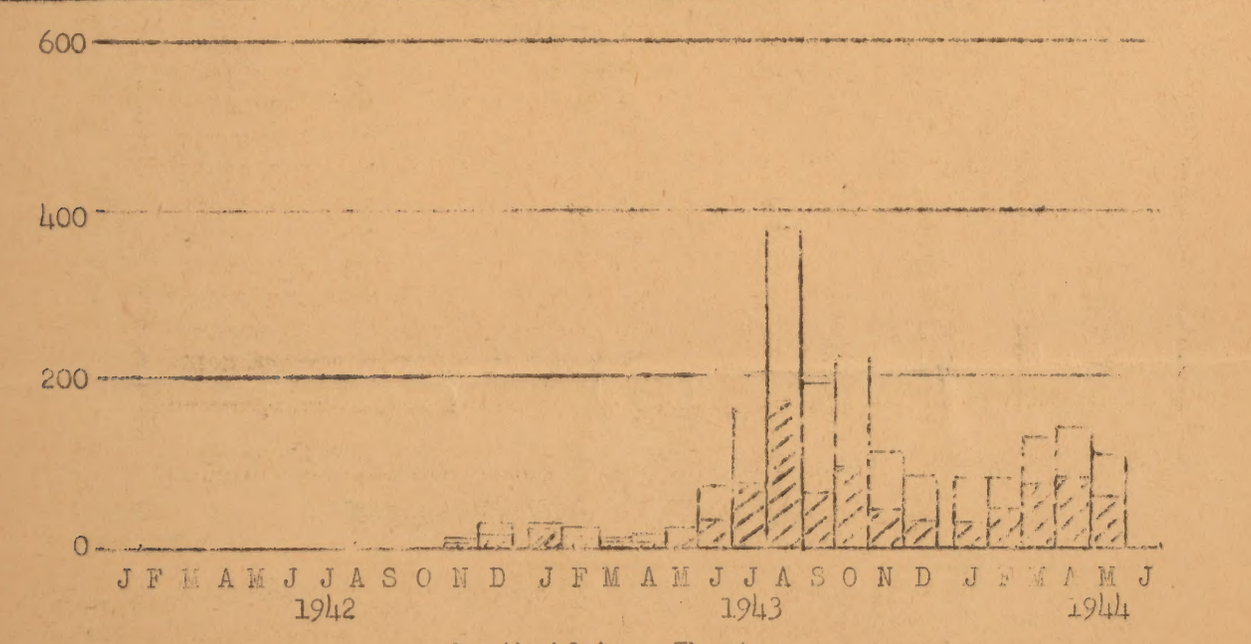
MALARIA AND FEVER OF UNDETERMINED ORIGIN
ADMISSIONS PER THOUSAND MEN PER YEAR



China-Burma-India Theater



Southwest Pacific Theater



North African Theater

MALARIA ATTACK RATE per/1000/annum for month of September 1944, for the weeks ending:

	USASOS	Sixth Army	5th A F	14th AA	USAFFE
Milne Bay					
9 Sept	4.1	0	(1 case)*	20	
16	4.1	0	0	00	
23	0	11	0	0	
30	2.05	0	0	0	

* Cannot figure satisfactory rate due to small number of AF Troops.

Oro Bay					
8 Sept	24	21	0	0	24
15	31	22	0	92	30
22	16	21	0	0	65
29	36	15	0	46	44

Lae			
8 Sept	30	0	0
15	12	(1 case)*	36
22	65	(2 ")*	17
29	27	(1 case)*	62

* Cannot figure satisfactory rate due to small number of 6A Troops

Finschhafen				
8 Sept	22	26	16	46.8
15	12.6	15.1	0	41.6
22	20.4	17.3	0	15.6
29	22	24.8	0	13.0

Hollandia	
8 Sept	34.9
15	37.9
22	33.1
29	14.4

Biak			
8 Sept	56.1	0	2.3
15	14.3	0	12.1
22	9.3	7.7	32.2
29	8.6	7.9	4.1